

be very liable to yellow rust; (3) this rust is always more prevalent in sunny parts of the field.

A hypothesis so revolutionary is not likely to be adopted by a cautious fungologist without further evidence. At present, as far as we know, no figures illustrating the development of the mycelium have been published, nor can we obtain details of the staining methods adopted. Klebahn (*loc. cit.*) has entered his protest to the theory, chiefly, however, in general terms. In regard to the prevalence of rust in sunny parts of a field, he points out that Eriksson's own results confirm the fact that dormant spores are induced to germinate by alternate cooling and heating, drought and moisture; just the conditions to be expected in early summer in sunny parts rather than in shaded parts of a field. Klebahn also supports the view that spores of rusts are capable of wider distribution than Eriksson's results show; for instance, they have been found in analyses of air. We may recall, in support of this, Robert Hartig's observation in the Tyrol, when, after showers of rain, a yellow dust, coating objects in the neighbourhood, was found to consist almost entirely of the yellow spores of a rust-fungus, *Chrysomyxa* ("Diseases of Plants," Tubeuf and Smith, London, 1897, p. 54). If it be the case, as Eriksson says, that certain rusts of cereals appear regularly in four or five weeks, it seems quite as likely to indicate external infection of young plants at a certain stage in their existence, as to support the theory of an internal germ. The Swedish experiments in isolating test-plants from contagion have been repeated in America by Bolley.<sup>1</sup> Young plants of cereals growing amongst others in a field were enclosed in rust-proof cases; they grew to maturity without showing any rust, although plants left unenclosed were much attacked. The results are quite negative.

Recent investigations have been directed towards advancing our knowledge regarding the varieties of cereals suited to resist the various forms of rust. Carleton,<sup>2</sup> whose work was aimed in this direction, summarises our general knowledge thus: "as yet there is but little certainty concerning rust resistance, which varies continually under different conditions. Heretofore, in testing varieties for rust resistance, little attention has been paid to the species of rust concerned." For our own part, we feel that our ability in combating the diseases of plants would be greatly strengthened by searching investigations towards attaining disease-proof varieties. A certain amount has been done, much more must yet be done. The results hold good for only small areas of the earth, and there must be thorough and systematic research in many countries before any definite conclusion be arrived at. From a practical point of view the combating of rusts of cereals, and diseases of plants generally, seems likely to be solved sooner in this way than by investigations on the complex conditions of life amongst the rust-fungi. One cannot but feel that the long recent researches have added to what we knew only minor details of practical importance, although they have opened new vistas of the deepest interest to the fungologist; the outstanding lesson is the close dependence of the fungi on their environment, and the complexity thereby introduced into the study of diseases of plants.

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### MEDICINE AS A SCIENCE AND MEDICINE AS AN ART<sup>3</sup>

IT has sometimes been disputed whether medicine should be regarded as a science or an art, but there is no doubt that the original meaning of the term medicine, in English and in other languages, is the Art of Healing. Medicine is so defined by Aristotle, and it has all the characters of an art. It depends upon experience and skill; it deals with individual cases; and the perfection it aims at is practical, not speculative: the knowledge how to do, not the knowledge how things happen.

Nevertheless, as practical navigation is founded on astronomy, meteorology and physics; as the art of agriculture rests on botany, geology and vegetable physiology, so the art of medicine depends on the science of pathology, the practice of physic on the principles of physic.

<sup>1</sup> *Centralblatt f. Bakt. u. Parasitenkunde*, Abt. II., vol. iv., 1898, pp. 855-9, 889-96, 913-9 (6 figs.). Also *Proc. Amer. Ass. Adv. Science*, 1898, p. 408 (the limits of this paper prevent a longer reference to this research).

<sup>2</sup> *Loc. cit.*, p. 69.

<sup>3</sup> Abstract of the Address in Medicine delivered before the British Medical Association at Ipswich, on August 1, by Dr. P. H. Pye-Smith, F.R.S.

On the one hand, then, we must never forget that we practice an art; we must never allow theories, or even what appears to be logical deduction, or explanations, however ingenious, or statistics, however apparently conclusive, or authority, however venerable, to take the place of the one touchstone of practical medicine, observation and experience. We must never treat the disease without considering the patient, for the art of healing is the art of healing individually; nor need we wonder if profound learning and the best scientific training sometimes fail to make a successful practitioner. For beside adequate knowledge to save us from gross blunders, and a strenuous endeavour to do your best for each individual patient, however uninteresting the case or however irksome and unrewarded our toil—beside these first requisites for our art, there is ample room for those personal qualities which ensure success in every department of life; for power of observation and insight, for the personal influence by which a strong character will secure obedience and inspire hope, for the judgment which divines what kind of remedies are suited to each patient, what kind and of what strength, and for the sympathy which puts one in the patient's place, and not only meets, but anticipates his wants.

On the other hand, however, if medical science without art is inefficient, medical art without science is not only unprogressive, but almost inevitably becomes quackery. As soon as we treat our patients by rule of thumb, by tradition, by dogmas, or by metaphysical axioms, we do injury to ourselves as well as to them. The bone-setter who is ignorant of anatomy; the wise woman, who cures by charm, are not more irrational or less successful than was the physician of the seventeenth century who, in obedience to the doctrine of signatures, advised an infusion of roses for hæmorrhage, and saffron for jaundice, and lung-wort for consumption; or the astrologer who prescribed salts of silver, of iron, copper, lead, or mercury in accordance with the horoscope of the patient and the planet under which he was born.<sup>1</sup> Not less mischievous, and in the true sense of the word unscientific, were the systems of medicine known as the Iatromechanical and the Iatrochemical, which in their turn had their vogue. The Brunonian system, explaining all diseases as due to laxity of fibre, was no better; for indiscriminate use of "corroborants," or as they would now be called "tonics," is irrational. There is no such thing as a tonic or strengthening medicine, the only source of strength is oxidisable food, and bitter medicines only give strength indirectly by improving appetite. The last of the systems of medicine founded on a dogma is homœopathy, of which the theoretical absurdity is somewhat concealed by the more obvious nonsense of infinitesimal doses. It, like the other systems which preceded it, is not a rival to rational medicine; they are not mistaken answers to a legitimate question, but attempted solutions of a problem which does not exist, attempted answers to a riddle which has none.

Apart from these exploded systems of treatment, our profession has often suffered from lack of the scientific, inquiring, sceptical spirit, and has often been led too easily by authority, by tradition, and by fashion. The reckless abuse of venesection in the last century and the former half of this led to almost complete disuse of a valuable means of treatment; the misuse of mercury in the treatment of syphilis led to the denial of its unquestionable efficacy; have we not seen the value of stimulants with fever lead to their indiscriminate use in almost every ailment? Has not the immense value of careful and thorough nursing led to its absurd exaltation to an independent place, as if good nursing was anything more than an intelligent carrying out of the physician's directions? Has not the remarkable powers of electrical stimuli led to a blind, unscientific and mischievous employment of this remedy, as if it had some mystic power apart from its demonstrable physiological effects? May we not say the same of hydropathy, of massage and of hypnotism? It is significant that the irrational exaltation of any of these particular modes of treatment into a panacea, while it begins in want of scientific intelligence invariably ends in imposture and deceit. Our only safeguard against the spirit of quackery and the deserved loss of public confidence in the

☉	♃	♄	♅	♆	♁	♁
Sol	Luna	Mars	Mercurius	Jupiter	Venus	Saturnus
Au	Ag	Fe	Hg	Sn	Cu	Pb
Sunday	Mon-day	Mardi	Mercredi	Thors-day	Vendredi	Saturday

These relations of metals to the planets, and also to the days of the week, are commemorated in the phrases:—*lunar* caustic, *marial* disposition, *mercurial* temperament, ♁ before a prescription, *Cuprum a Cypro* (*diapoteus Cypri*) and *saturnium* gout.

profession which it brings with it, is continued recurrence to the scientific basis on which the practice of medicine rests. Our art is most satisfactory and efficient when most closely resting on science. The surgeon is continually guided by anatomy and mechanics in dealing with injuries and deformities. The physician is often able to apply his knowledge of chemistry and natural history to the direct and satisfactory treatment of disease. In general, medical science justifies its claim to the title by the same conclusive argument as astronomy or chemistry—by its predictions coming true. In particular, the detection and treatment of plumbism, the diagnosis and cure of scabies and ringworm, the treatment of poisons by chemical antidotes, and of specific diseases by attenuated inoculations are all instances of strictly scientific medicine. Nor can I refrain from citing the most recent and one of the most remarkable advances of our science in the discovery of the origin of malaria. This heavy tax upon national as well as individual vigour and happiness has been known and treated from the dawn of medicine; but although by a happy accident its efficient treatment was discovered, it is only lately that, by the combined labours of scientific physicians—Frenchmen, Italians, and our own countrymen—the origin of the disease has been discovered, the mode of its transmission traced, the diagnosis of its several forms established, and its prevention brought within reasonable hope.

We know that treatment of symptoms without a diagnosis is always unsatisfactory, and frequently worse; but we know also that diagnosis must rest upon accurate knowledge of morbid anatomy, and of the natural history of the disease. Scientific medicine based on observation and experiment is always practical as well; but empirical medicine, whether based upon fanciful speculation or working by blind rule of thumb, is the most unpractical thing that can be.

*Preventive Medicine and Aetiology.*—That important and constantly-growing branch of medicine, which deals with the prevention rather than the cure of disease, depends no less upon science, for tracking the dependence of one event upon another is the essence of inductive science. All efficient measures for the preservation of health, whether by individuals or communities, rest upon exact knowledge of the natural course of diseases. In fact, disease may be defined as the reaction of the human organism under conditions which make for its destruction. We must never forget that no irritant will cause inflammation in a lifeless skin; that no bacteria can produce fever without a nervous system to play upon; that no meal, however Gargantuan, and no potatoes, however deep, can produce their wonted effect without a stomach to react. The infection of small-pox, of diphtheria, or of tubercle exerts a very different influence upon vaccinated or unvaccinated subjects, upon one who has received and one who has not received the prophylactic serum, upon an organism which is predisposed to or refractory against the invasion of the enemy. How closely natural science is related to preventive medicine is shown by the history of Jenner, who was a naturalist, and of Pasteur, who was a chemist. How dependent we are upon science is well illustrated by the history of myxœdema. The cretinoid condition in adults which was discovered by the clinical acumen of Sir William Gull, unintentionally produced by the surgical skill of Prof. Kocher, and reproduced in animals by Mr. Horsley, is now cured by the eminently scientific method due to Dr. Murray, of Newcastle, and to Dr. Hector Mackenzie, of St. Thomas's Hospital. Such examples of accurate tracing of causation by observation and experiment admonish us to give up the perfunctory explanations which so often do duty for investigation. If we ascribe every inflammation to cold, and every vague complaint to gout; if we acquiesce in the popular ascription of disease to over-work, mental strain, and the nervous tension of modern life, we shall make no progress in true aetiology. I see many patients suffering from idleness—few, or none, from hard work. "Nerve-prostration" from "worry" and "brain-tension" often proves a decent synonym for the effects of gambling and drink. Modern life is easier, safer, and smoother than it was a hundred years ago. Our young men and maidens are healthier, stronger, better grown, less hysterical and sounder in mind and body than their great-grandparents. I venture to think that the duty of a physician is not to flatter the self-love of neurotic patients, but to inspire fortitude, and to prescribe regular and steady work as the best cure for a thousand nervous ailments.

As another point in scientific aetiology, allow me to warn against the temptation to assume that because many diseases are now proved to depend upon the presence of bacteria this must be true of all. Science does not anticipate, but waits for proof. We have complete scientific evidence, according to the criteria so well formulated by Koch, of the absolute and constant cause of anthrax, of relapsing fever, of tubercle, and several other diseases in both men and animals; but we must not forget the preliminary difficulty of identifying the specific bacillus—as in the case of enteric fever and diphtheria—nor the difficulty of finding one of the lower animals which is susceptible to the disease, as again in the case of typhoid fever and of cholera; nor the difficulty of the same anatomical and clinical conditions being produced by different organisms, as in the case of pneumonia and ulcerative endocarditis. Moreover, while in some diseases, which are undoubtedly infective and specific, no constant pathogenic microbe has yet been determined—as in typhus, measles, small-pox, and syphilis—we have, on the other hand, in the case of leprosy and of lupus, examples of disease unquestionably specific and bacterial in origin, but very unlike other infective maladies in their clinical course and natural history. At present it is surely undesirable to speak of "the undiscovered microbe of rheumatism." Science has to do with proved facts alone, and our language should never outrun our knowledge.

*Experiments in Scientific Medicine.*—There is one aspect of scientific medicine so important that it must not be omitted—the necessity of experiments for the progress of pathology, and, through it, for the prevention and cure of disease. It requires no argument to convince any one who is the least acquainted with the principles of inductive science that experiment is no less necessary than observation. In physics and in chemistry this is obvious and universally acted on. The same method is indispensable for the progress of animal and vegetable physiology, and to such practical applications of science as engineering, agriculture and medicine. Nor can experiments be restricted to rare occasional and solemn occasions; they must be carried on in large numbers, by many different experimenters, and under every variety of condition. Any attempt to abolish, to check or to limit this experimental work is, in the degree that it is successful, fatal to progress. Happily it can never be successful, for the impulse to increase knowledge of the works of creation is too deeply implanted in men. Investigation must and will go on by the only path which it can follow. The method which was preached by Bacon and followed out by his great contemporary, William Harvey, which was continued by Lower, Hooke and Mayow in the early days of the Royal Society, by Aselli, Malpighi and Haller, by Hunter, Hewson and Hales, by Edward Jenner, by Sir Charles Bell, by Johannes Müller, by Claude Bernard, by Ludwig, and by the many eminent physiologists and pathologists in Germany, in France and throughout the civilised world, this method of investigation is absolutely necessary for the progress of our science and the improvement of our art. As its objects and methods are better understood, it will secure the enlightened patronage of all who desire the diffusion of human knowledge and the further spread of human happiness. Fortunately this very progress of science has brought with it the removal of the one grave drawback, as every right-thinking man must have felt it, to the benefits of these experiments upon living animals. Inflicting pain upon the humblest of God's creatures is repugnant to our feelings, though no one, unless maintaining a thesis, would contend that it is wrong to exact the most painful efforts, or even the death from exhaustion of a horse in order to carry help to a human being. But the discovery of ether, chloroform, and other anaesthetics, and the improved methods that we owe to the genius of Lister, have not only relieved the surgeon of the most repulsive part of his duties, but have relieved the experimenter also. Except in the investigation of the action of new remedies or in the inoculation of infective diseases, both of which inflict discomfort of a limited degree and duration rather than anything that can be described as pain, the experiments of the laboratory, whether physiological, pathological or therapeutical, are conducted without inflicting pain. The opposition to them has not succeeded, and is sure to diminish. However mistaken our opponents, we are glad to find there is even exaggerated jealousy to avoid anything approaching to cruelty. This legitimate object our more candid critics may be assured is already amply provided for.